

## We claim:

- 1           1. An apparatus for applying a thin film coating to a
- 2           substrate comprising:
  - 3           a vacuum chamber connectable to a pump adapted to
  - 4           evacuate said chamber;
  - 5           at least one crucible in said chamber;
  - 6           a substrate holder in said chamber receiving a
  - 7           substrate to be coated and juxtaposed with said crucible;
  - 8           a mechanical shutter in said chamber interposable
  - 9           between said crucible and said substrate;
  - 10          a high-energy source for heating a component of a
  - 11          coating to be deposited upon said substrate in said crucible;
  - 12          a radio frequency or pulsed direct current source
  - 13          connectable to said substrate holder for producing a plasma
  - 14          around said substrate and imparting a self-bias to said substrate
  - 15          holder poling said substrate holder cathodic;
  - 16          means for feeding a gas mixture to said chamber
  - 17          including at least one gas reactive with said component to form a
  - 18          coating on said substrate; and
  - 19          a low energy electron source for ionizing said
  - 20          component to reduce said self-bias and deposit a reaction product
  - 21          of said component and said at least one gas on said substrate,
  - 22          said shutter being movable from one said crucible and said
  - 23          substrate to permit ionization of said component.

1                   2. The apparatus defined in claim 1 wherein said  
2 substrate holder is mounted for rotation in said chamber.

1                   3. The apparatus defined in claim 2 wherein said  
2 chamber is formed with an insulated feed-through for connecting  
3 said source to said substrate holder.

1                   4. The apparatus defined in claim 3, further  
2 comprising an instrument for measuring the thickness of said  
3 coating on said substrate for controlling the deposition of said  
4 reaction product on said substrate.

1                   5. The apparatus defined in claim 4 wherein said  
2 crucible is electrically heated.

1                   6. The apparatus defined in claim 4 wherein said  
2 component is heated in said crucible by sputtering.

1                   7. The apparatus defined in claim 4 wherein said  
2 source is a radio frequency source.

1                   8. The apparatus defined in claim 4 wherein said  
2 crucible is rotatable in said chamber.

1                   9. The apparatus defined in claim 4, further  
2 comprising another crucible containing a respective component  
3 capable of forming a reaction product which can be deposited on  
4 said coating.

1                   10. The apparatus defined in claim 4 wherein said  
2 component is heated in part by an electron beam gun.

1                   11. The apparatus defined in claim 10, further  
2 comprising another electron beam gun in said chamber for heating  
3 said component.